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EXAMINER

YAMNITZKY, MARIE ROSE

ART UNIT	PAPER NUMBER
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1786

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PAPER

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Office Action Summary	Application No. 10/540,733	Applicant(s) KATHIRGAMANATHAN ET AL.	
	Examiner Marie R. Yamnitzky	Art Unit 1786	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 12 November 2009 and 12 February 2010.
- 2a) ☒ This action is **FINAL**. 2b) ☐ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 74,76-83 and 85-102 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 74,76-80,82,85-89,91-96,98 and 100-102 is/are rejected.
- 7) ☒ Claim(s) 81,83,90,97 and 99 is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
 2. ☐ Certified copies of the priority documents have been received in Application No. _____.
 3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- | | |
|-------------------------------------------------------------------------------------|-------------------------------------------------------------------|
| 1) <input type="checkbox"/> Notice of References Cited (PTO-892) | 4) <input type="checkbox"/> Interview Summary (PTO-413) |
| 2) <input type="checkbox"/> Notice of Draftperson's Patent Drawing Review (PTO-948) | Paper No(s)/Mail Date. _____ |
| 3) <input type="checkbox"/> Information Disclosure Statement(s) (PTO/SB/08) | 5) <input type="checkbox"/> Notice of Informal Patent Application |
| Paper No(s)/Mail Date _____ | 6) <input type="checkbox"/> Other: _____ |

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1. This Office action is in response to the Application Data Sheet filed November 12, 2009, and applicant's amendment filed February 12, 2010, which amends the specification, amends claims 74, 83, 87, 88, 91, 99 and 102, and cancels claim 103.

Claims 74, 76-83 and 85-102 are pending.

2. The objection to the declaration filed July 27, 2005, as set forth in the Office action mailed October 05, 2009, is overcome by the Application Data Sheet filed November 12, 2009.

The objection to the amendment filed July 20, 2009 under 35 U.S.C. 132(a), as set forth in the Office action mailed October 05, 2009, is overcome by the amendment filed February 12, 2010.

The rejections under 35 U.S.C. 112, 1st and 2nd paragraphs, as set forth in the Office action mailed October 05, 2009 are overcome by amendment. (With respect to the question as to whether the molecular orbital limitations pertain to molecular orbital level or molecular orbital energy, the examiner interprets the limitations as pertaining to molecular orbital level. This interpretation is consistent with the information provided by applicant on page 15 of the response.)

3. Given the clarifying amendments to the claims, the examiner has reconsidered rejections under 35 U.S.C. 103(a) that were set forth in the Office action mailed February 18, 2009, and withdrawn subject to claim clarification in the Office action mailed October 05, 2009. Some of the previously applied prior art is reapplied in this Office action. Arguments previously made by

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applicant with respect to the art have been taken into consideration when reapplying the art, and are addressed later in this action.

4. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

5. Claims 74, 76, 78, 79, 85, 88, 89, 91, 92, 94, 95 and 100 are rejected under 35 U.S.C. 103(a) as being unpatentable over Egusa et al. (US 5,343,050) in view of Verhoeven et al (US 2003/0012979 A1).

Egusa et al. disclose an electroluminescent (EL) device comprising, in the order listed, an anode, a hole transporting layer, multiple layers of light emitting material, an electron transporting layer, and a cathode. The multiple layers of light emitting material consist of alternating layers of two materials wherein one of the materials has a larger band gap than the other. The light emitting material with the smaller bandgap has a higher HOMO level and a lower LUMO level relative to the HOMO and LUMO levels of the light emitting material with the larger bandgap. For example, see Fig. 27, Fig. 57, Fig. 58, column 28, line 17-c. 29, l. 16 and Example 38 (c. 68, l. 15-c. 69, l. 21; with the chemical formulae for (C82) and (C84) shown in c. 66).

Egusa's device of Example 38 has an anode made of ITO, a cathode made of aluminum, a layer of hole transport material, a layer of electron transport material, and a light emitting layer consisting of multiple films of a light emitting material having a band gap of 2.1 eV and multiple films of a light emitting material having a band gap of 2.5 eV, with a film of the 2.5 eV band gap material being disposed between each successive pair of films of the 2.1 eV material, and each film having a thickness of 3 nm. The material having a band gap of 2.1 eV has a higher HOMO level and a lower LUMO level than the material having a band gap of 2.5 eV.

The device structure of Egusa's Example 38 meets the limitations of the device of claims 74, 76, 78, 79, 85 and 88 except for the composition of the layers of light emitting material (i.e. the layers of first and second metal complex). With respect to claims 89, 91, 92, 94, 95 and 100, Egusa's Example 38 does not meet the composition of the layers of light emitting material (first and second metal complex), and also does not meet the thickness limitations recited in claims 89 and 91 (with claims dependent from 91). Each of the present claims requires a first and second electroluminescent metal complex and/or electroluminescent organometallic complex. Further, claim 89 requires some of the sublayers of first and second complexes to have a thickness of about 10 nm, and claim 91 and dependents require some layers to have a thickness of about 23 nm and other layers to have a thickness of about 10 nm. Egusa et al. do not disclose the use of electroluminescent metal complexes and/or organometallic complexes as the light emitting materials and, as previously noted, each of the films of light emitting material in Egusa's Example 38 device has a thickness of 3 nm.

A variety of different metal complexes were known in the art at the time of the invention as being suitable for use as light emitting materials in the light emitting layer of an electroluminescent device, and the various known metal complexes do not all have the same band gap.

For example, Verhoeven et al. disclose luminescent lanthanide metal complexes that may be used in EL devices. Verhoeven et al. teach that the complexes in which the metal is Ce(III), Eu(II) or Tm(III) emit blue light, Tb(III) complexes emit green light, Eu(III), Dy(III) and Sm(III) complexes emit orange/red light, and Nd(III), Yb(III) and Er(III) complexes emit near infra-red light. For example, see paragraphs [0001] and [0015]-[0019].

It would have been within the level of ordinary skill of a worker in the art at the time of the present invention to utilize other known light-emitting materials to make a device having a light emitting layer made of alternating layers of materials of different band gaps as taught by Egusa et al. One of ordinary skill in the art at the time of the invention would have been motivated to provide a device having a light emitting layer made of alternating layers of materials of different band gaps for the advantages of such a device construction as taught by Egusa et al., and it would have been within the level of ordinary skill of a worker in the art at the time of the invention to select combinations of two light-emitting materials within Egusa's guidelines.

Verhoeven's complexes are electroluminescent metal complexes, with some complexes having larger band gaps than other complexes. Accordingly, combinations of complexes can be selected from Verhoeven's complexes to provide the alternating layers of different band gaps as

required by the present claims and as required for embodiments within the scope of Egusa's disclosure. Verhoeven's complexes include complexes meeting the further limitations recited in present claims 78, 79, 94 and 95.

With respect to the thickness limitations of present claims 89 and 91 and dependents, each of the multiple films within the light emitting layer of Egusa's device of Example 38 has a thickness of 3 nm, but Egusa's embodiment having the multiple films of alternating band gaps is not limited to thicknesses set forth with respect to Example 38. Absent a showing of criticality for a thickness of about 10 nm for some of the sublayers as in present claim 89, or for a thickness of about 23 nm for some layers and about 10 nm for other layers as in present claim 91 and dependents, it is the examiner's position that it would have been within the level of ordinary skill of a worker in the art at the time of the invention to determine suitable thicknesses for the various layers sufficient to provide a functional device.

6. Claims 77, 86, 87, 93, 101 and 102 are rejected under 35 U.S.C. 103(a) as being unpatentable over Egusa et al. (US 5,343,050) in view of Verhoeven et al (US 2003/0012979 A1) as applied to claims 74, 76, 78, 79, 85, 88, 89, 91, 92, 94, 95 and 100 above, and further in view of Mori et al. (US 5,281,489).

With respect to claims 77 and 93, the hole injection (transporting) layer of Egusa's Example 38 is made of an aromatic amine that is very similar to TPD, but lacks the two methyl groups of TPD. TPD was known in the art at the time of the invention to be useful as a hole transporting material as evidenced by Mori et al. (e.g. see col. 4, l. 44-46). Further, all of the

compounds listed in claims 77 and 93 were known in the art at the time of the present invention, and are tertiary aromatic amine compounds as generically taught by Mori et al. as useful hole transporting materials (e.g. see c. 4, l. 46).

With respect to claims 86, 87, 101 and 102, Egusa's Example 38 uses a benzoxazole compound in the electron injection (transporting) layer, rather than a metal quinolate complex. Metal quinolate complexes were known in the art at the time of the invention to be useful as electron transporting materials as evidenced by Mori et al. (e.g. see col. 8, l. 29-30; and see Example 63 in which an aluminum quinolate is used).

It would have been within the level of ordinary skill of a worker in the art at the time of the invention to determine other suitable hole transporting materials and other suitable electron transporting materials, selected from materials known in the art at the time of the invention, that could be used to make devices similar to Egusa's device of Example 38.

7. Claims 74, 76-80, 82, 85-89, 91-96, 98 and 100-102 are rejected under 35 U.S.C. 103(a) as being unpatentable over Egusa et al. (US 5,343,050) in view of Kathirgamanathan (WO 98/58037).

Egusa et al. disclose an electroluminescent (EL) device comprising, in the order listed, an anode, a hole transporting layer, multiple layers of light emitting material, an electron transporting layer, and a cathode. The multiple layers of light emitting material consist of alternating layers of two materials wherein one of the materials has a larger band gap than the other. The light emitting material with the smaller bandgap has a higher HOMO level and a

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lower LUMO level relative to the HOMO and LUMO levels of the light emitting material with the larger bandgap. For example, see Fig. 27, Fig. 57, Fig. 58, column 28, line 17-c. 29, l. 16 and Example 38 (c. 68, l. 15-c. 69, l. 21; with the chemical formulae for (C82) and (C84) shown in c. 66).

Egusa's device of Example 38 has an anode made of ITO, a cathode made of aluminum, a layer of hole transport material, a layer of electron transport material, and a light emitting layer consisting of multiple films of a light emitting material having a band gap of 2.1 eV and multiple films of a light emitting material having a band gap of 2.5 eV, with a film of the 2.5 eV band gap material being disposed between each successive pair of films of the 2.1 eV material, and each film having a thickness of 3 nm. The material having a band gap of 2.1 eV has a higher HOMO level and a lower LUMO level than the material having a band gap of 2.5 eV.

The device structure of Egusa's Example 38 meets the limitations of the device of claims 74, 76, 78-80, 82, 85 and 88 except for the composition of the layers of light emitting material (i.e. the layers of first and second metal complex). With respect to claims 89, 91, 92, 94-96, 98 and 100, Egusa's Example 38 does not meet the composition of the layers of light emitting material (first and second metal complex), and also does not meet the thickness limitations recited in claims 89 and 91 (with claims dependent from 91). Each of the present claims requires a first and second electroluminescent metal complex and/or electroluminescent organometallic complex. Further, claim 89 requires some of the sublayers of first and second complexes to have a thickness of about 10 nm, and claim 91 and dependents require some layers to have a thickness of about 23 nm and other layers to have a thickness of about 10 nm. Egusa et al. do not disclose

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the use of electroluminescent metal complexes and/or organometallic complexes as the light emitting materials and, as previously noted, each of the films of light emitting material in Egusa's Example 38 device has a thickness of 3 nm.

A variety of different metal complexes were known in the art at the time of the invention as being suitable for use as light emitting materials in the light emitting layer of an electroluminescent device, and the various known metal complexes do not all have the same band gap.

For example, Kathirgamanathan disclose luminescent metal complexes that may be used in EL devices. In addition to the complexes set forth in Kathirgamanathan's examples, which do not all emit the same color, this reference also demonstrates by way of discussion of various prior art disclosures that various luminescent metal complexes capable of emitting different colors were known in the art at the time of the invention.

It would have been within the level of ordinary skill of a worker in the art at the time of the present invention to utilize other known light-emitting materials to make a device having a light emitting layer made of alternating layers of materials of different band gaps as taught by Egusa et al. One of ordinary skill in the art at the time of the invention would have been motivated to provide a device having a light emitting layer made of alternating layers of materials of different band gaps for the advantages of such as a device construction as taught by Egusa et al., and it would have been within the level of ordinary skill of a worker in the art at the time of the invention to select combinations of two light-emitting materials within Egusa's guidelines.

Kathirgamanathan's disclosure demonstrates that various electroluminescent metal complexes, with some complexes having larger band gaps than other complexes, were known in the art at the time of the invention. Accordingly, combinations of complexes can be selected from known complexes to provide the alternating layers of different band gaps as required by the present claims and as required for embodiments within the scope of Egusa's disclosure.

Complexes of Kathirgamanathan's examples and/or complexes of the prior art discussed in this reference meet the further limitations recited in present claims 78-80, 82, 94-96 and 98. For example, with respect to the metals required for claims 79, 82, 95 and 98, see the fifth paragraph on page 3. The Eu complex of Kathirgamanathan's Example 6 is $\text{Eu}(\text{DBM})_3\text{OPNP}$, which meets the limitations of the first complex as further defined by present claims 78-80 and 94-96.

$\text{Eu}(\text{TMHD})_3\text{OPNP}$, which is also recited in present claim 80 and meets the limitations of the first complex as further defined by present claims 78-80 and 94-96, is not expressly provided as an example in Kathirgamanathan's disclosure, but would have been *prima facie* obvious to one of ordinary skill in the art at the time of the invention given the complex of prior art Example 1, which is $\text{Tb}(\text{TMHD})_3\text{OPNP}$, and the similar Eu complex of prior art Example 10.

With respect to claims 77 and 93, the hole injection (transporting) layer of Egusa's Example 38 is made of an aromatic amine that is very similar to TPD, but lacks the two methyl groups of TPD. TPD was known in the art at the time of the invention to be useful as a hole transporting material, and is taught for that use by Kathirgamanathan in the first paragraph on page 5 (also see p. 16 and the claims of this reference). Further, all of the compounds listed in

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claims 77 and 93 were known in the art at the time of the present invention to be useful hole transporting materials.

With respect to claims 86, 87, 101 and 102, Egusa's Example 38 uses a benzoxazole compound in the electron injection (transporting) layer, rather than a metal quinolate complex. Metal quinolate complexes were known in the art at the time of the invention to be useful as electron transporting materials, and are taught for that use by Kathirgamanathan in the third paragraph on page 5 (also see p. 16 and the claims of this reference).

It would have been within the level of ordinary skill of a worker in the art at the time of the invention to determine other suitable hole transporting materials and other suitable electron transporting materials, selected from materials known in the art at the time of the invention, that could be used to make devices similar to Egusa's device of Example 38.

With respect to the thickness limitations of present claims 89 and 91 and dependents, each of the multiple films within the light emitting layer of Egusa's device of Example 38 has a thickness of 3 nm, but Egusa's embodiment having the multiple films of alternating band gaps is not limited to thicknesses set forth with respect to Example 38. Absent a showing of criticality for a thickness of about 10 nm for some of the sublayers as in present claim 89, or for a thickness of about 23 nm for some layers and about 10 nm for other layers as in present claim 91 and dependents, it is the examiner's position that it would have been within the level of ordinary skill of a worker in the art at the time of the invention to determine suitable thicknesses for the various layers sufficient to provide a functional device.

8. Applicant's arguments filed July 02, 2009 have been taken into consideration when making the rejections set forth above.

Applicant argued that independent claims 74, 88 and 91 require the layer or layers comprised of the second metal complex to have a "thickness of about 10 nm". Applicant pointed to Example 1 in the specification as demonstrating the criticality of the "thickness of about 10 nm" limitation.

Applicant argued that the data in the specification demonstrate that using a layer of the second complex having a thickness of about 10 nm, and having the specified band gap and other properties recited in the claims, provides a significant and unexpected increase in luminous efficiency compared to a similar device having a layer of the second complex with a thickness greater than 10 nm.

Present independent claims 74 and 88, and claims dependent from claim 74 presently limit the layer (or layers, in the case of claim 88) of second complex to a thickness of "about 10 nm or less" (emphasis added). The alternating layers of larger band gap and smaller band gap materials in Egusa's device of Example 8 each have a thickness of less than 10 nm. The only limitation of claims 74, 88 and some claims dependent from 74 that is not met by Egusa's device of Example 8 is the use of a metal complex for the larger band gap and smaller band gap materials, but metal complexes known in the art at the time of the invention can be used.

In the case of claim 89, the thickness of each of the sublayers located between the first and last sublayer of the first complex must have thickness of about 10 nm; the thickness of the first and last sublayer of the first complex is not limited. The data of record do not demonstrate

that providing certain sublayers of metal complex with a thickness of about 10 nm is critical and/or provides unexpected results compared to a similar device in which each of the sublayers of metal complex has a thickness of less than 10 nm as would be done if one substituted known metal complexes having the appropriate relative band gaps and HOMO and LUMO levels to provide a device similar to that of Egusa's Example 38.

In the case of claim 91 and dependents, some layers of metal complex are required to have a thickness of about 10 nm and some layers of metal complex are required to have a thickness of about 23 nm. The data of record do not demonstrate that providing certain layers of metal complex with a thickness of about 10 nm and others with a thickness of 23 nm is critical and/or provides unexpected results compared to a similar device in which each of the layers of metal complex has a thickness of less than 10 nm as would be done if one substituted known metal complexes having the appropriate relative band gaps and HOMO and LUMO levels to provide a device similar to that of Egusa's Example 38.

9. Claims 81, 83, 90, 97 and 99 are objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

The examiner previously included claims 81 and 90 in a rejection based on Egusa et al. in view of Kathirgamanathan et al. on the basis that the fifth paragraph on page 2 of the Kathirgamanathan reference mentions that metal complexes that emit in the ultraviolet region are

known. The examiner has reconsidered the teachings of both references and does not reapply the rejection to claims 81 and 90 (and similar claim 97).

The fifth paragraph on page 2 of the Kathirgamanathan reference states “[r]are earth chelates are known which fluoresce in ultraviolet radiation”. It is possible that the phrase “in ultraviolet radiation” could refer to the excitation light rather than to the emission light. Since the emission wavelength is generally longer than the excitation wavelength, fluorescence emitted upon excitation by UV light will not necessarily be in the wavelength range of UV light.

Further, while Egusa provides a device structure comprising alternating layers of light emitting materials having the relative band gaps and HOMO and LUMO levels required by the present independent claims, Egusa does not suggest using a light emitting material that emits UV light. All the light emitting materials utilized by Egusa emit in the visible light region of the spectrum.

10. Applicant’s amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a).

Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

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11. Any inquiry concerning this communication should be directed to Marie R. Yamnitzky at telephone number (571) 272-1531. The examiner works a flexible schedule but can generally be reached at this number from 7:00 a.m. to 3:30 p.m. Monday and Wednesday-Friday.

The current fax number for all official faxes is (571) 273-8300. (Unofficial faxes to be sent directly to examiner Yamnitzky can be sent to (571) 273-1531.)

/Marie R. Yamnitzky/
Primary Examiner, Art Unit 1786

MRY
May 20, 2010